HAWTHORNE SILVER AND IRON MINES, LIMITED

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The EDITH *and* LORNE PIERCE
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Queen's University at Kingston

REPORT ON

The Wilbur Iron Properties

and other portions of the

Kingston & Pembroke Iron Region

(Canada)

Under the control of the

Hawthorne Silver and Iron Mines, Limited

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The Wilbur Iron Properties

and other portions of the

Kingston & Pembroke Iron Region

(Canada)

LOCATION.

These properties are situate in the eastern part of the Province of Ontario, some 60 miles from Kingston, a port on Lake Ontario; between the St. Lawrence and Ottawa Rivers, just half way between Montreal and Toronto; in the counties of Lanark and Frontenac and on the Kingston and Pembroke Railway, a part of the Canadian Pacific System.

REGARDING THE PAST ABOUT IRON IN CANADA

Before describing the properties which will constitute the subject, of this report, it will assist in understanding the present condition of iron mining in Canada, and the important position occupied by these properties, if I first say a few words on the earlier condition of this industry and give a very short sketch of the general character of the deposits on which these mines are situated and of the mode of occurrence of the iron ores in the surrounding district.

In the earlier days of mineral development in Canada, it was a common belief that this country possessed many large deposits of available ores, although a very few of them had been analyzed and in any case the exact composition was not then regarded as of so much importance as it is at the present time. In those days any ore that would answer for making the commonest castings was considered good enough for our needs. Since the introduction of the Bessemer process a sharp line has been drawn between ores suitable for this process and

those which are not. These now form two distinct classes, the non-Bessemer kinds being scarcely counted at all as marketable at this date.

When the larger deposits of Canadian ores came by degrees to be tested, most of them had to be ruled out, as being non-Bessemer in composition. In fact, many of them were found to be so impure as to be of little or no value for making iron for any purpose. Besides often proving to be of inferior quality, the supposedly large deposits were frequently found to be much smaller than had been supposed. Although a few large and good deposits of iron ore have been shown to exist in different parts of Canada, the once imagined abundant source of such ores has not materialized and a supply of easily accessible good ores for continued use, sufficient to make Canada independent of other countries, cannot be said to be in sight. This fact gives additional value to such large deposits of good ore as are proved to exist in this country.

As the present report deals only with magnetite, I will confine my remarks to ores of this class. The published literature on the iron ores of Canada being meagre and defective, the writer will depend on his own observations for the information on the subject which is herein utilized. Referring to the country generally, some of the Canadian ores, resembling good magnetites, were found to contain so much titanium that they had no value at all. The writer called attention to the association of these titaniferous ores with rocks containing plagioclase or the striated feldspars, and ventured the prediction, which had been verified, that where such feldspars were present, any magnetite in the vicinity would be found to be rich in titanium. In some of the large deposits of ore where this metal was absent the proportion of silica was excessive; in others again the percentage of sulphur or phosphorous was too high; so that it was rare to find a deposit of magnetite sufficiently free from these harmful components and at the same time large enough to be profitably worked under present conditions.

It is to be observed that the distribution of good or marketable ores is not sporadic in its nature; or, in other words, the occurrences of

distinct types of ore are not, geographically speaking, mixed up in any given region. The underlying cause is no doubt geological, but at any rate, it is a fact that ores of a certain class occur with considerable uniformity within certain general boundaries. Thus between the north-eastern part of Lake Ontario and Pembroke on the Ottawa River the magnetites in general belong to a superior class.

As this rule may be pretty generally applied, and as the district is the nearest to market and the most accessible of the iron ore regions of Canada, the value of any deposit here becomes only a question of its size.

GEOLOGY OF THE DISTRICT

The iron bearing region traversed by the Kingston and Pembroke Railway affords a typical example of the Upper Laurentian series of rocks and it happens to comprise more occurrences of good iron ores than any other known area in Canada. The series here consists essentially of alternate great beds of light colored or nearly white crystalline limestone and distinctly stratified gray and reddish gneisses together with interbedded layers of magnetic iron ores. The process of deposition was that of ordinary sedimentation. The gneisses are not of the kind which owe their lamination to pressure and shearing but were originally deposited on an even bottom on the form of mud or silt composed of clay and sand, while the limestone and the iron oxide were thrown down as chemical precipitates. In the country on the east side of the railway line is a tract of diorite or amphibolite, more than 20 miles in length running in a northerly direction from the Mississippi nearly to the Madawaska River, with a breadth in the centre, of six miles and having an area of about 60 square miles.

The eruption of this great mass of igneous rock may have preceded the formation of the limestone and the gneisses. It contains magnetite throughout and has many scattered centres of impregnation holding notable percentages of iron in the form of disseminated magnetite. In a traverse of about three miles which I made through the 11th range of lots in the 3rd, 4th and 5th concessions of Lavant in

which the rock was almost continuously exposed, these feruginous centres were quite frequent. A specimen representing them, analyzed by Dorfman, gave 25.70 per cent. of metallic iron.

Specimens of diorite thickly impregnated with crystals of magnetite taken at two different localities on lot 10 in concession 4 in this township gave respectively 26.60 and 28.00 per cent. of iron. A sample formed by crushing together twelve equal fragments from a ridge composed of mixed crystalline amphibolite and magnetite, and forming a large volume of rock on lot 9 in the 5th concession of Lavant which was analyzed by Mr. H. A. Leverin, Chemist of the Dominion Department of Mines, yielded 28.5 per cent. of iron. On lot 12 in the 2nd concession of the same township I saw a mass of crystalline magnetite about 100 feet in diameter at the surface of which Mr. Leverin found to contain 56 per cent. of iron.

The origin of the ore beds at the Wilbur Mines may perhaps be connected in some way with the proximity of this large tract of iron-bearing volcanic rock. At the time of the formation of these beds the surface of the igneous rocks which come within two miles of the mines may have been exposed to weather or other conditions while perhaps in a heated condition and they then supplied abundance of iron in some soluable form, which flowing westward was precipitated in great quantities immediately on top of the great underlying bed of carbonate of lime, which had by that time become sufficiently consolidated.

EXTENT OF PROPERTIES.

Caldwell Purchase (Wilbur Properties)	5,672 Acres		
Owned under Miner's License	100 "	5,772	Acres
Other properties controlled	11,032 "		
Water Power	433 "	11,465	"
Total Acreage owned or controlled		17,237	"

SCOPE OF PRESENT REPORT

After having visited, at various times, a considerable number of the ore discoveries on the above properties, and having obtained a

sufficient knowledge to enable me to judge of the remainder, there is no doubt in my mind that the deposits on the Wibur properties (Caldwell purchase) constitute altogether the largest, most continuous and self-contained of them all.

In estimating the commercial value of a workable body of iron ore, three factors are to be considered, of which the first is quantity, which should be sufficient to last for years; the second quality, which should be pure enough for making the highest grade of metal; and the third the distance to market and present accessibility.

As the Wilbur properties are highly favored by all three of these conditions, I shall deal mainly with these in the present report.

It should be understood, that the intention is not to underestimate the value of the others; but as the Wilbur properties cover some 5600 acres and are developed to a considerable extent already, disclosing millions of tons of ore, their full description alone should prove sufficient for the purposes of this report.

WILBUR PROPERTIES. (CALDWELL PURCHASE.)

The total area of the Caldwell purchase is 5672 acres comprising 36 lots, averaging each 200 acres more or less lying in the township of Lavant and North Sherbrooke, County of Lanark and in the township of Palmerston, County of Frontenac. The four lots on which the principal mine openings have been made and which include the mining properties thus far developed embrace lots 3 and 4, concession 12 and lots 3 and 4 concession 13 of the township of Lavant, being a part of the 5672 acres. About 4000 acres lie in one parcel, the extreme dimensions of which are about 4.3 miles in one direction and by 3.5 miles in another. The line of the strike of the developed main ore body falls within the property boundaries for a total distance of over 3.5 miles.

In the northern part of the developed area, are three distinct beds of magnetite. They are separated from one another by interstratifying bands of gneiss and crystalline limestone. The most

westerly of these beds has been opened by a vertical shaft, towards the bottom of which the ore has been stoped to a limited extent on either side.

The depth of this shaft is 80 feet. Its walls show a mean thickness of 15 feet of gneiss rock next the surface, followed by 60 feet of magnetite resting on crystalline limestone, into which the sump extends about 5 feet.

At 91 feet east of the Vertical Shaft another bed of magnetite, higher up in the series, crops at the surface. This bed has been mined for 256 feet down a slope, having an inclination of 20 degrees. The excavation is called The Inclined Shaft and it is open to the sky for the first 104 feet, when it passes underground for the remaining 152 feet. This ore bed begins near the natural surface with a thickness of a few feet and increases to about 30 feet at the above distance. The band of rock which intervenes between the bottom of the ore bed of the Inclined Shaft and the top of that of the Vertical Shaft has a thickness, at right angles to the dip of 53 feet.

At 120 feet north-eastward of this open pit, this one is called, a bore hole was sunk at right angles to the bedding and passed through a 30 feet of ore.

As the 60 feet bed of magnetite in the Vertical Shaft may be assumed to dip regularly at the same angle beneath the Inclined Shaft, the united thickness of the two beds will be about 90 feet of ore, separated by 53 feet of rock.

At a horizontal distance of 375 feet eastward from the western extremity of the open pit, another pit of considerable width, called the Bull pit, was opened on a third bed of ore underlaid by crystalline limestone. This ore is of a coarsely crystalline texture, and it is also of good quality.

If these openings should, as supposed, represent only three separate and important beds of magnetite they will add enormously to the known quantity of ore on the property and will greatly increase the rapid productiveness of the mines by allowing additional workings to be carried on simultaneously.

The big bed of magnetite, which is at present undergoing development at No. 1 Incline Shaft, some 1565 feet to the south of the Vertical Shaft, has been proved to consist of ore of high grade quality. As a bed, it forms a member of the series of regularly and evenly stratified rocks of the Upper Laurentian formation as already stated. The ore bed, as well as the gray gneiss immediately above and the crystalline limestone immediately below it, dip to the east-south-east at angles which average about from 20 to 25° to the horizon.

Starting with the main workings which commence underground at the edge of the big bed, near the centre of the property, its western boundary runs northward, with a gentle curve to the west for 2254 feet and southward 550 feet or more. An Inclined Shaft following the dip or slope, has been driven eastward in the ore bed to a distance of 380 feet. For a short distance, midway down the shaft, the dip flattens to an angle of 8 to 10 degrees, then resumes the average angle and towards the present termination it becomes steeper. Cross-cuts and stopes have been made on either side of the Inclined Shaft.

All the evidence available as to the forms taken by the beds of magnetite resting on crystalline limestone and covered by gneiss indicates that the lower surface undulates in the form of smooth rolls or swells and depressions running in different courses which causes the thickness to vary more or less in any direction. In some other mining regions, the thicker parts of such deposits take the form of separated lenses along the same bed plane or horizon, but on these properties the ore beds have nowhere been found to pinch out entirely, although the lower or big bed has been pierced by some 30 bore holes.

ANALYSES OF WILBUR MINES ORES

The following analyses of iron ores from the properties, have been made by official and other recognized chemists at various times. From this list it will be seen that the general character of the ore from all parts of the property is of high grade.

ANALYST	LOCALITY	Fe.	P.	S.
H. A. Leverin	Vertical Shaft	49.65	.005	.049
" " "	Incline "	56.02	.006	.015
" " "	Bull Pit "	54.41	.021	.012
" " "	Inclined "	64.70	.007	.015
" " "	4 Wilbur "	64.10	.003	.016
A. Dorfman	Edgar Shaft, Robertsville	49.83	.005	.013
" "	Mary Shaft, Robertsville	49.46	.000	.014
" "	Lot 16	55.32		
" "	Vertical Shaft	52.82	.006	.014
" "	Kelly Mine	63.50	·005	.008

ESTIMATED TONNAGE OF ORE

The known dimensions of the big bed are as follows: Length on strike 2254 feet, breadth on slope to bottom of workings, 380 feet: Average thickness 50 feet. This gives a total of 37,800,000 cubic feet of ore. Allowing 6 cubic feet to the ton, this gives 6,300,000 tons of ore. But we may fairly assume that this ore body extends under the ground on its dip to a distance equal to its length on the strike. This would give us, allowing the same thickness, 233,280,000 cubic feet or 38,860,000 tons. The length of the big bed on the strike is very likely to be much greater than the present known measurements of 2254 feet.

In addition to the known dimensions above stated of the ore bodies, my observations will allow me to say that the range may be traced by reason of the formation, by the occurrence of out-croppings and by the reading of the dip needle, for a distance of 2200 feet south of the present workings and for a distance of 2000 feet northward, making a total observed linear extent of the range to be 6454 feet and which, if found to be correct would naturally enormously increase the estimate above given.

The two other ore beds, one of which at least has a known thickness of 30 feet, will undoubtedly contain very large ore bodies. As they are not sufficiently developed as yet, the tonnage has not been estimated in figures, but I am of the opinion, that once developed,

these would disclose an aggregate quantity of ore probably as great as that in the big bed.

DIAMOND DRILLINGS

Aside from the large amount of development work described, a portion of the above properties have been already quite extensively prospected by means of the diamond drill, some of the borings having penetrated more than 500 feet. The accompanying map will indicate in detail the location of many of these bore holes.

There are at the present moment three complete diamond drilling plants on these properties and the proving up of the ore bodies which is already in progress will be continued uninterruptedly on various points selected by me and will in all probability increase the ultimate production to an extent which might prove hard to estimate.

REMARKS

I need not dwell on the equipment of the mine, as I suppose such matters will be treated of by others, but I may be allowed to mention that it is well supplied with the necessary buildings of all kinds, machinery, pumps, shops and elevated floors and bins for loading the ore upon the cars. From the latter a good spur-track, about a mile in length, with a very easy grade, connects the mine with the main line of the Kingston and Pembroke Railway, a part of the Canadian Pacific System. The proximity of the Wilbur Railway station and the Post Office, with daily mails both ways, are among the many conveniences enjoyed by these properties within a settled community.

In addition to magnetite, the region served by the Kingston and Pembroke Railway possesses a number of other economic minerals. Among them may be mentioned hematite, copper, lead, zinc, a little gold, graphite, talc, feldspars, for porcelain, various kinds of marble, fine mica in large sheets, and apatite.

THE ROBERTSVILLE MINES

The Robertsville property, including the 600 acres recently acquired under option, comprises a total of about 1500 acres. The whole of this area is included in one block situated in the southeastern

part of the township of Palmerston, County of Frontenac. It is traversed by the Kingston and Pembroke Railway, and has a spur track from the main line to one of the shafts. About 12 good sized dwelling houses, besides other buildings, form a small village near this track. Good wagon roads from various directions lead to it.

Since my visit to these mines in April last, I have lately gone over the ground and studied it more thoroughly, and I now submit the following additional report.

The ores, which have been proved to exist in various separate sections of the property, consist of high-grade magnetite of great purity. The rocks in which they occur are made up of various kinds of gneiss, granite and syenite, crystalline limestone, hornblende schist, and a rock which is locally, but incorrectly, called taconite. The general direction of the strike of the whole group is from southwest to northeast, and the dip is to the southeast.

The iron ores form two belts, both of which run with the general strike. The belt lying towards the southeast is, apparently, the principal one, and it seems to run on the same course with great regularity. But it appears to be accompanied by internal disturbances, which, following along the belt, are manifested by a vein-like structure in some parts, by small dislocations at various angles, and by local mixing of large and small angular masses of the ore with portions of the country rock.

At the principal shaft on this ore belt, called the Lizzie, much of the ore is very coarsely crystalline and associated with pure calcite, black hornblende, and a few other minerals. Sulphides of iron and other metals, however, appear to be entirely absent. The Lizzie shaft has been sunk to a depth of 208 feet in a solid body of magnetite, which conforms with the general stratification, and has a dip of 51 degrees to the southeast. At the surface, the ore-body has a thickness of 30 feet, and while the foot-wall proved to be almost a plane surface, the hanging-wall was found to widen out rapidly until it had attained a thickness of 67 feet, which it maintained for a depth of over 208 feet from the surface.

Bore-holes were both drilled from a point, on ground, situated about 400 feet to the southeast of the Lizzie shaft. One of these holes was drilled towards the Lizzie at an angle of 45 degrees and under the bottom of this shaft it passed through 20 feet of ore mixed with some rock. This ore was encountered at 282 feet, following the inclination of the bore-hole. The other hole, which started within a few inches of the first, followed an inclination of 51 degrees from the horizon. At 312 feet at this angle, it struck a body of good ore, which proved to be 25 feet in thickness, showing that the mass was rapidly widening out with depth.

The rocks through which the bore-holes passed consisted of alternations of several varieties of gneiss, interstratified with bands which might be called dioritic rocks, together with some hornblende schist. Calcite or crystalline limestone was found in contact with the iron ore for a limited thickness both above and below it. Underneath the limestone of the foot-wall, a rock, locally called taconite, extended to the limit reached in the bore-hole, which was about 15 feet below the base of the ore. The so-called taconite might be termed a silicous diorite.

The Lizzie shaft is situated two or three hundred yards north of the main wagon road. Southwestward from it, three pits or openings have been made on the line of the iron belt, and the ore exposed in them shows an increasing thickness as the shaft is approached. Northeastward of it, three more pits have been opened on the ore streak in the space of about 200 yards. A wagon road, constructed mostly of broken iron ore, runs alongside of the course of the ore body to the distance of nearly a mile, when the Edgar shaft is reached. This shaft or opening has a length of about 100 feet in an east and west direction, which is somewhat diagonal to the general course of the ore band. At a short distance farther to the northeast, or beyond the Edgar shaft, within that portion of the property which was acquired from Mr. P. WHITE, a smoothly glaciated flat surface of solid magnetite is exposed. In continuing this northeasterly course as far as Mr. White's residence, the magnetic needle shows a dip of 90 degrees in two places

with lower dips in the intervals on the line of the ore belt. It may be here mentioned that at one place on the southeast or opposite side of the road paved with magnetite, a few beds of iron ore were observed in the gneiss, running parallel to the main ore streak.

The Mary shaft is situated on the second belt of ore already mentioned and runs northeast and southwest, or parallel to the belt on which the Lizzie shaft has been sunk. This shaft lies north of the Lizzie, and distant four or five hundred yards from it. The excavation itself runs north and south and has a length of about 100 feet, with a breadth of about 50 feet and is 180 feet deep. It is situated at the foot of an east-facing bank or slope which shows good ore all along the west side of the shaft. A pit, which I was unable to visit, was opened on this range at a distance of about 500 yards from the Mary shaft. At a distance of thirty or forty yards up the even slope to the northwest of the brink of this shaft, a small area of smoothly glaciated rock-surface is exposed beneath the shallow soil. Here the whole mass is seen to consist of solid magnetite, broken up and mixed on a large scale with less than an equal proportion of granite. The contacts of the ore-masses and the granite are angular and irregular, the two constituting a breccia on a large scale. Farther on in a northwesterly direction, and on higher ground, five irregular openings have been made in a similar mixture of iron ore and granite. The ore has been removed, leaving irregular excavations or pockets, having angular, pointed and jagged sides and bottoms, which consist of the rocky portions from which the ore has been excavated. These present a jumbled mixture or rather fine grained crystalline patches of the ore and black hornblende, which is here called by the miners "black jack," together with somewhat fine-textured granite, weathering to a light gray color. These different varieties of rock, including the ore itself, all contain a good deal of epidosite in the form of uneven, thick and thin stringers, and irregular patches of various shapes and sizes. There is also some quartz and feldspars. The jagged pockets, just referred to, measure 30 feet or more in diameter, although there are some others of smaller size. A short tunnel has also been excavated in this iron-bearing rock.

Having as already stated, dealt with these mines in a previous report, I shall omit further details, and will only point out once more, that this extensive property may be counted upon to supply very large quantities of ore for a long time to come, and that the extent of the ore bodies, the thickness of the ore beds, and the high quality of the ores, will very favorably compare with those described in the Wilbur properties.

OTHER PROPERTIES

From the Schedule given elsewhere in this report it has been shown that your Company's holdings are very extensive and although my present examination has extended over a period of two months I have only been able to go over extensively and examine in detail the Wilbur properties.

It should be remembered that these alone comprise about 5600 acres and the other properties not described here will cover at least an additional 10,000 acres and that it would require many months of continued study to examine carefully this large area extending over a number of square miles.

Certain portions of these I have visited and among the most important ones I would mention the Clyde River property in Lavant township, where I had an opportunity to see a very large deposit of magnetite but on none of these have I really been able to spend enough time to be as yet in a position to report upon them.

In obtaining early possession of these additional properties, before the opportunity of doing so might be lost, the Company has taken a prudent step. On account of the frequency of the occurrence of good magnetite throughout this district, I have no doubt that when the Company shall cause a thorough exploitation of its holdings, a number of good mines will be discovered in addition to those which have already been found in a few months. Owing to the good quality of the magnetite of this district in general, for the reason elsewhere stated, I have a great confidence that the other deposits which will come to light will also be of high grade.

LARGE WATER POWER AT RAGGED CHUTES

The splendid water power you have secured at the Ragged Chutes on the Mississippi River, is a most valuable asset. This is perhaps the largest stream in this part of Canada, and as it draws its waters from a rocky region covered with forest and likely to remain so, a steady stream is assured. In order to make quite certain of an abundant supply at all times, the large number of rock bound lakes on its various branches offer great facilities for unlimited storage. These chutes consist of two steep falls of at least 40 feet each with a short interval between them, so that the whole 80 feet or more can be utilized at the one spot and the ground affords ideal places for erecting buildings and machinery.

The privilege of using a steady supply of cheap power will so greatly reduce the cost of mining throughout the district as to make the difference in some cases between making a profit or a loss. Being in the midst of the mines, this great supply of power, so close at hand, will cheapen all the processes connected with mining to the extent of revolutionizing the former expenditure. It can be conveniently utilized at every mine for drilling, pumping, hoisting, loading and hauling cars and for all other purposes besides leaving a margin to be leased for operating other industries.

CONCLUSIONS

Having at various parts of this report referred to the magnitude of the properties, the extent of the ore bodies, and the high quality of the ore, it should not be necessary to summarize my conclusions under a separate heading, unless to point out once more the important and most favorable location of the properties.

In comparison with the largest ore deposits now operated, it can readily be seen that your properties occupy a most commanding position as they are considerably nearer, and are, in fact, but a short distance from the principal iron markets. The largest portion of your holdings are on the line of the railroad with an average distance of not more than 60 miles from Kingston, the Port on Lake Ontario.

With abundant labor and timber available for all mining purposes and a water power capable of furnishing several thousand horsepower, your ores can be mined at a very small cost and because of the close proximity to the markets you will be entitled to very favorable freight rates so that your operations should under all circumstances yield handsome profits.

The large extent of your ore bodies again will easily make possible a production of a million tons annually.

Respectfully submitted,

(Signed) ROBERT BELL.

Wilbur, Ontario, August 23, 1910.